

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Hisense USA Corporation
Petitioner

v.

Brightplus Ventures LLC
Patent Owner

Patent No. 9,605,835
Filing Date: February 2, 2015
Issue Date: March 28, 2017
Title: SOLID-STATE LUMINAIRES FOR GENERAL ILLUMINATION

Inter Partes Review No. IPR2023-01168

**Ex. 1036 – Declaration of P. Morgan Pattison, Ph.D. in Response to Patent
Owner’s Revised Contingent Motion to Amend**

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I, P. Morgan Pattison, declare as follows:

I. Introduction

1. I am an independent consultant. I am over eighteen years of age, and I would otherwise be competent to testify as to the matters set forth herein if I am called upon to do so.

2. I have prepared this Declaration for consideration by the Patent Trial and Appeal Board in the *Inter Partes* Review of U.S. Patent No. 9,605,835 (“the ’835 Patent”) and the Revised Contingent Motion to Amend (the “Motion”) Filed by Patent Owner in that *Inter Partes* Review Proceeding.

3. I provide this Declaration at the request of and have been retained by Kilpatrick Townsend & Stockton, LLP, which represents Hisense USA Corporation (“Hisense”) in connection with the above-captioned *Inter Partes* Review. I have been informed and understand that Hisense contends that substitute claims 21-29 submitted by the Patent Owner in the Motion are invalid.

4. I am being compensated at an hourly rate of \$550 per hour. My compensation is not dependent on the outcome of or any issue in relation to the above-captioned *Inter Partes* Review, and I have no interest in either party.

5. In forming my opinions, I relied on my knowledge, education, experience, and training in the field and on documents and information referenced in this Declaration.

6. My qualifications are summarized in Ex. 1003, which is my prior declaration in this proceeding and my CV, which was submitted as Ex. 1004. *See* Ex. 1003, ¶¶6-15. I am not a lawyer, however, my understanding of the legal issues, in particular with respect to obviousness are summarized in my prior declaration. *See* Ex. 1003, ¶¶16-23. My prior declaration also provides my opinion on the appropriate level of experience for a person to be a person of ordinary skill in the art. *See* Ex. 1003, ¶¶25-28.

II. Materials Considered

7. In addition to the materials identified in my prior declarations (*see* Ex. 1003, ¶30; Ex. 1022, ¶7) in forming my opinions, in addition to my knowledge and experience, I have considered the following documents and things that I have obtained, or that have been provided to me:

Exhibit	Description
1024	Rough Transcript of July 12, 2024 Deposition of William Bohannon
1025	Exhibit 8 to Deposition of William Bohannon, 3M United States, Prism Films
1026	Exhibit 9 to Deposition of William Bohannon, Vikuiti™ Brightness Enhancement Film (BEF) II
1027	Excerpts of Prosecution History of Application No. 13/657,141, entitled Solid State Luminaires for General Illumination, and to which the '835 Patent Claims Priority
1028	Final Transcript of July 12, 2024 Deposition of William Bohannon
1029	US 2005/0231943A1 to Sloan <i>et al.</i> ("Sloan")

1030	Korean Patent Application No. KR20050012372A, entitled “Luminescent diode package and method for manufacturing led package” to Park (“Park”)
1031	Certified Translation of Exhibit 1030, Korean Patent Application No. KR20050012372A, entitled “Luminescent diode package and method for manufacturing led package” to Park (“Park”)
1032	Chinese Patent Application No. CN1693962A, entitled “LED backlight system of packing LED using three primary colors (RGB)” to Li <i>et al.</i> (“Li”)
1033	Certified Translation of Exhibit 1032, Chinese Patent Application No. CN1693962A, entitled “LED backlight system of packing LED using three primary colors (RGB)” to Li <i>et al.</i> (“Li”)
1034	US 2005/0047134A1 to Mueller <i>et al.</i> (“Mueller”)
1035	US 2007/0046485A1 to Grootes <i>et al.</i> (“Grootes”)

8. In addition to the documents above, in forming the opinions expressed below, I have also considered my own knowledge and experience based upon my education, research and work in the fields of optics, LEDs, and display technology, as described above and in my *curriculum vitae* (Ex. 1004).

III. Patent Owner’s Substitute Claims.

9. I am informed and understand that Patent Owner has proposed to substitute original claims 1-5, 7, 9, 10, and 13 of the ’835 Patent with the following substitute claims (the “Substitute Claims”):

21. (proposed substitute for Claim 1) A lighting panel, comprising:
at least one substrate comprising a metal core printed circuit board having traces formed thereon mounted on a lighting tile and having a first side parallel to a principal plane of the lighting panel;

a plurality of strings of packaged solid state lighting devices arranged on the first side of the at least one substrate and configured to emit light;

wherein the plurality of strings of packaged solid state lighting devices is mounted on the lighting tile;

wherein a lens is mounted over each one of the packaged solid state lighting devices;

a controller configured to control the plurality of strings of packaged solid state lighting devices;

wherein the controller is operable to deliver a control signal to a plurality of current supply circuits that are operable to control the pulse width of the current supplied to each one of the plurality of strings of packaged solid state lighting devices using information transmitted to the controller over a communication link;

a reflector mounted to the lighting tile and on the first side of the at least one substrate, the reflector being outside of the packaged solid state lighting devices;

wherein the reflector extends to cover the lighting tile and includes a plurality of sidewalls outside of the packaged solid state lighting devices that are angled with respect to the principal plane of the lighting panel;

a brightness enhancement film on the reflector, wherein the reflector is arranged between the at least one substrate and the brightness enhancement film and the brightness enhancement film is configured to preferentially emit light having a first orientation from the lighting panel and to preferentially reflect light having a second orientation, different from the first orientation, back into the lighting panel, and

a generally planar diffuser sheet between the reflector and the brightness enhancement film, wherein the generally planar diffuser contacts the reflector, and wherein the light having the second orientation that is reflected back into the lighting panel is recycled within at least the diffuser sheet.

22. (proposed substitute for Claim 2) The lighting panel of claim 1 21, ~~wherein the reflector comprises a coating on the substrate that is configured to reflect and scatter light incident thereon~~ wherein the lens surrounds each of the packaged solid state lighting devices.

23. (proposed substitute for Claim 3) The lighting panel of claim 1 21, ~~wherein the reflector comprises a reflector sheet that is configured to reflect and scatter light incident thereon~~ wherein the generally planar

diffuser contacts the sidewalls of the reflector with no intervening elements.

24. (proposed substitute for Claim 4) ~~The lighting panel of claim 1 23, further comprising at least one additional layer on the brightness enhancement film configured to diffuse, polarize, collimate and/or reflect light wherein the generally planar diffuser is offset from the packaged solid state lighting devices.~~

25. (proposed substitute for Claim 5) ~~The lighting panel of claim 1 21, wherein respective ones of the apertures include angled sidewalls to thereby form reflective optical cavities around the corresponding ones of the plurality of solid state lighting devices wherein the controller transmits control signals to a plurality of current supply circuits.~~

26. (proposed substitute for Claim 7) ~~The lighting panel of claim 3 25, wherein the reflector sheet comprises a plastic foam wherein at least one of the current supply circuits transmit pulse width modulated signals to one or more of the plurality of strings of packaged solid state lighting devices.~~

27. (proposed substitute for Claim 9) ~~The lighting panel of claim 1 26, wherein the brightness enhancement film comprises a plurality of three dimensional light extraction features configured to bend at least some light rays passing through the brightness enhancement film toward the direction normal to the principal plane of the lighting panel wherein the current supply circuits are operable to individually control the current to each of the strings of packaged solid state lighting devices.~~

28. (proposed substitute for Claim 10) ~~The lighting panel of claim 9 27, wherein the light extraction features are random features wherein the pulse width modulation of the current delivered to each of the strings of packaged solid state lighting devices is based on one or more of: user input, ambient light information or other input.~~

29. (proposed substitute for Claim 13) ~~The lighting panel of claim 9 21, wherein the brightness enhancement film is configured to substantially collimate light emitted by the lighting panel wherein the reflector is substantially planar to the surface of the lighting tile where the reflector is on the at least one substrate.~~

IV. The Prior Art Renders Every Element of Substitute Claims 21-29 Obvious.

10. In my prior declaration I broke down the elements of claims 1-5 and 7-14 and demonstrated that each of the elements of those claims were known in the art before the April 21, 2006, priority date of the '835 Patent. *See* Ex. 1003, ¶¶41-157. In the analysis below I address the new elements of Substitute Claims 21-29 and demonstrate that each of these elements was also known in the art before the April 21, 2006, priority date of the '835 Patent.

11. As discussed in my prior declaration, the combination of references in Ground 1 (Mok (Ex. 1005), Holman (Ex. 1006), and Lamb (Ex. 1007)) discloses or renders obvious each element of original claim claims 1-5 and 7-14, and it would be obvious to combine those three references. The same is true of the of references in Ground 2 (Epstein (Ex. 1008), Holman (Ex. 1006), and Lamb (Ex. 1007)). The references of Ground 1 and Ground 2, along with other prior art, disclose substitute claims 21-29 as well, and it would be obvious to combine these disclosures with Ground 1 or Ground 2.

A. At Least One Substrate Comprising A Metal Core Printed Circuit Board Having Traces Formed Thereon Mounted On A Lighting Tile” (Substitute Claim 21[a])

12. Substitute claim 21[a], which is essentially aimed at a metal core printed circuit board mounted on a lighting tile, covers elements that were well known in the art before April 2006.

13. This is demonstrated, for example, by Mok, which states that “[b]ecause each of the light emitting elements needs to be electrically connected to a source of electrical power, it will be convenient in most applications for the base panel 12 to comprise a printed circuit board, although this is not required. In an embodiment wherein the base panel 12 comprises a printed circuit board, the light emitting elements 14 may be electrically connected (e.g., by soldering) to pads (not shown) provided on the base panel 12. The pads of the base panel 12 may then be connected to drive circuitry (not shown) suitable for providing the required electric current to the light emitting elements 14.” Mok, [0019]. Thus, Mok’s base panel 12 is a lighting tile which may have a PCB mounted to it. Mok,

14. A POSITA would understand that PCB, as used in Mok, is a generalized term for printed circuit boards, of which there are a number of types such as metal core, FR4, and Teflon printed circuit boards. *See* <https://www.mainpcb.com/pcb-substrates/>. In particular, metal core printed circuit boards are commonly used in LED systems, as demonstrated by Sloan, which states “Different types of metal core boards can be used such as an aluminum core board. By being metal core, heat from the light elements conducts into the PCB such that the PCB 18 helps draw away heat from the light elements 22, 24.” Sloan, [0039]. Indeed, such Metal Core Printed Circuit Boards (MCPCB) were well known in the art as of the priority date of the ’835 Patent and still are commonly

used. A person of ordinary skill in the art would recognize that there are multiple advantages of MCPCBs, including: (1) Heat dissipation: MCPCBs can transfer heat much faster than regular PCBs, this is due to the use of metal, which is a natural heat conductor, which functions to dissipate heat away from the components, which helps keep them cool and prevents damage to the circuit. (2) Increased performance and life: Keeping the heat generating components cool increases their performance and life. For example, the MCPCB design can help extend the lifespan of an LED. (3) Reduced vibration: The core of the board reduces vibration, so components don't fall off in environments where the larger device is in motion, e.g., in airplane seatback displays. (4) Durability and strength: The metal substrates used in MCPCBs are long-lasting and strong. (5) Non-toxic and recyclable: Metals are non-toxic and can be recycled. *See, e.g.,* <https://www.mainpcba.com/pcb-substrates/>.

15. In view of these advantages, and that MCPCBs were well known in the art, a POSITA would have been motivated to use a MCPCB in Mok's design (to the extent Mok does not already expressly disclose such a PCB as noted above). Indeed, such a MCPCB would be desirable for use in Mok, for example, because of its excellent heat dissipation properties, as well as the fact that they allow for the necessary electrical connections, as shown by Mok which states "light emitting

elements needs to be electrically connected to a source of electrical power.” Mok, [0019].

16. Substitute claim 21[a] is also disclosed by Epstein, which states that “[t]he display panel 302 of the lighting unit 300 comprises a number of tiles 304.” Epstein, [0039]. The tiles 304 in Epstein “comprise a substrate 308, a guiding layer 310 and an optional contrast/projection filter 312” along with “a number of light emitting elements 306.” Epstein, [0039]. The substrate of the tile is a lighting tile as in substitute claim 21[a].

17. Epstein then goes on to state that “[c]onductors may be provided on different layers for carrying electrical current to and from the LEDs 420. For example, conductors may be provided on any of the substrate 408, the intermediate layer 422 and/or the guiding layer 410 to carry current to and from the LEDs 420. The conductors may take the form of metallic traces, for example formed from copper.” Epstein, [0051]. To the extent this does not expressly disclose a MCPCB, a POSITA would be motivated to use such a MCPCB in the Epstein design due at least to the multiple cooling and longevity advantages provided by a MCPCB, as discussed above.

18. Park and Li further demonstrate that substitute claim 21[a] was known in the art. Park describes a “wiring part on which the light emitting diodes are mounted” where “the wiring part is a metal core PCB.” Park, Abstract. Finally, Li

states that “several RGB unit-packaged LEDs are soldered onto an aluminum-based PCB 12 by an SMT process. This aluminum-based PCB has been designed with corresponding circuits according to the arrangement of the LEDs and is responsible for the input of the LED light source driving power and the output of feedback signals (such as temperature, color, etc.).” Li, 5.

19. A person of ordinary skill in the art would have been motivated to use the MCPCB, which is expressly disclosed in Park and Li, in the Mok and Epstein designs for all the reasons discussed above.

B. Plurality of Strings of Packaged Solid States Lighting Devices (Substitute Claim 21[b])

20. Substitute claim 21[b]’s only addition is to state that the solid state lighting devices are packaged and in strings, which were both well-known elements in the art. Indeed, the most common and efficient way to connect and drive LEDs in arrays of lighting panels is in the form of strings. Strings refers to electrically connecting LEDs, whether in parallel or series circuits or a combination of such, and placed on the circuit board, in a 1D or 2D array. This was common and ubiquitous because forming electrical connections in this manner is efficient from a manufacturing and design perspective. Further, as a POSITA would recognize, often single LEDs do not, by themselves, provide sufficient lighting, thus a POSITA includes multiple LEDs in a string in order to increase the amount of light. Arranging the LEDs in strings of series and/or parallel circuits

also enables the required voltage-current combination to be optimized for efficient power delivery to the circuit. This was a common sense solution in use in multiple applications years before the priority date of the '835 Patent. Indeed, this arrangement can be seen in virtually any technical reference or prior art that describes the arrangement of LEDs in a panel display.

21. This is demonstrated, for example, by Grootes, which describes “LED light source for backlighting... that can store optimal current settings for strings of LEDs.” Grootes [0010].

22. Further, Mok states that “[t]he base panel 12 provides a convenient mounting location for the various light emitting elements 14, allowing them to be arranged in a two dimensional array or pattern over both the length 38 and width 40 of the base panel 12. Mok, [0019]. As strings of LEDs were well known in the art, a POSITA would understand that one possible arrangement of the LEDs in Mok would be strings of LEDs.

23. Similarly, LEDs have been common off-the-shelf components sold in “packages,” that include, e.g., wiring and a transparent shell. Such components were sold long before the priority date of the '835 Patent. That packaged LEDs were extremely common, off the shelf elements is shown by a number of references as well. *See, e.g.*, <https://www.ledsmagazine.com/leds-ssl-design/packaged-leds/article/16695263/understand-the-true-cost-of-led-choices-in->

ssl-systems-magazine. Holman, for example, states that LEDs may be “manufactured in two types of packages: clear plastic elements of a wide variety of sizes and shapes, or 1.5- 3.0 mm square ceramic surface mounts suitable for conventional printed circuit boards. The physical package size determines how many lumens can be supplied in a given application area. The package's optical design determines the characteristic with which the lumens are emitted. Some packages have a lens that causes a more directional emission of light.” Holman, 25.

24. Epstein discloses the same, stating that its “LEDs may be packaged LEDs.” Ex. 1008, [0044]. A POSITA would recognize that this package refers to the LED, it’s conductors, and a transparent shell in which the LED is positioned.

25. Similarly, Park describes “a light emitting diode package which has a plurality of high-power light emitting diodes mounted in a package form.” Park, Abstract. And Li discloses “an LCD backlight system using three-primary-color (RGB) unit-packaged LEDs” where “[t]he RGB LEDs are packaged in a unit device.” Li, Abstract.

C. Wherein The Plurality Of Strings Of Packaged Solid State Lighting Devices Is Mounted On The Lighting Tile (Substitute Claim 21[c])

26. Mounting the strings of packaged solid state lighting devices on the lighting tile, as in Claim 21[c], would have been obvious to a POSITA as of the priority date of the ’835 Patent as well.

27. This is shown by Mok, which states “[t]he base panel 12 provides a convenient mounting location for the various light emitting elements 14, allowing them to be arranged in a two dimensional array or pattern over both the length 38 and width 40 of the base panel 12. Mok, [0019]. As I have previously explained, the base panel 12 of Mok is a lighting tile according to the claims of the ’835 Patent.

28. Epstein discloses substitute claim 21[c] as well, stating “[t]he display panel 302 of the lighting unit 300 comprises a number of tiles 304” where the tiles include a substrate layer 308/408 and “each tile 304 comprises a number of light emitting elements 306,” which are “packaged LEDs.” Epstein, [0039], [0044], [0046]. Again, as I have explained, the tile 304 of Epstein is a lighting tile. Thus, the packaged LEDs are mounted on the substrate, which is part of the lighting tile in Epstein.

29. Park further discloses substitute claim 21[c], describing “a plurality of high-power light emitting diodes mounted in a package form” wherein the “light emitting diodes [are] mounted on the wiring part.” Park, Abstract. A POSITA would recognize that the “wiring part,” of Park is a lighting tile. As explained in the ’835 Patent, a lighting tile is “a functional building block” upon which “one or more circuit elements, such as discrete light emitting components, may be mounted.” ’835 Patent, 8:21, 8:27-30. Similarly, the wiring part of Park is a

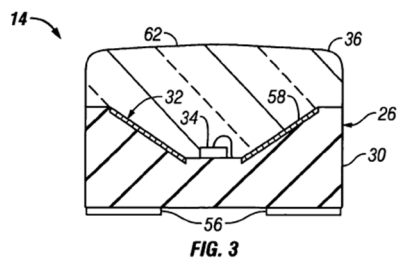
substrate, or building block, upon which the LEDs are mounted. Park, 1. Thus, the wiring part of Park would be understood to be a lighting tile as defined in the '835 Patent.

30. Li also discloses substitute claim 21[c], as it states “a plurality of several RGB unit-packaged LEDs are soldered onto an aluminum-based PCB 12.” Li, 5. The same is true of Grootes, which states that “the LEDs are first mounted and electrically connected on a printed circuit board (PCB).” Grootes, [0011]. In both Li and Grootes the PCB is a lighting tile. This is because, as stated in the '835 Patent, a lighting tile “may include, for example, a printed circuit board (PCB)” or “a metal core PCB (MCPCB).” '835 Patent, 8:27-33. Thus, the PCBs of Li and Grootes meet the '835 Patent's explicit stated definition of a lighting tile.

D. Wherein A Lens Is Mounted Over Each One Of The Packaged Solid State Lighting Devices (Substitute Claim 21[d])

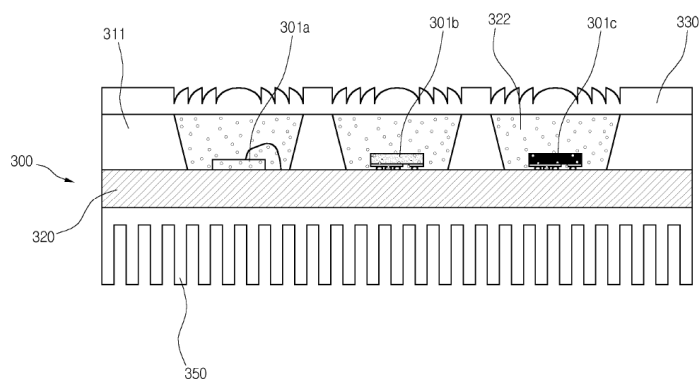
31. Mounting a lens over each packaged solid state lighting device as in substitute claim 21[d] is another obvious combination of well-known components.

32. Indeed, this is explicitly disclosed by Mok, which describes a lens 36 that it “formed over the diode junction 34 and reflector cup 32 in the manner best seen in FIG. 3.” Mok, [0029].



33. Holman’s disclosure of packaged LEDS with “a lens that causes a more directional emission of light” further supports the obviousness of substitute claim 21[d]. Holman, 25. Indeed, a POSITA would realize that mounting a lens over each packaged LED in Holman would be key to achieving Holman’s goal of greater light emission.

34. Park explicitly discloses substitute claim 21[d] as well, describing a “the lens part 330 which includes the Fresnel lenses having a plano-convex lens structure [] coupled with the reflection cup part 311.” Park, 7. As shown in Figure 3, the lens part 330 is mounted over the LEDs 301a, 301b, and 301c. Park, Fig. 3.



35. Similarly, Li states that “Li “above each RGB unit-packaged LED light source in the light source module, there is a lens (light diffuser) designed

using the principles of a binary optical system. The optical structure of this lens can be designed according to actual needs, resulting in a specific and relatively uniform radiation pattern, which greatly simplifies subsequent optical design.” Li, 10. A POSITA would understand that for a lens to be above the LEDs as it is in Li, the lens would have to be mounted over the LEDs.

E. A Controller Configured To Control The Plurality Of Strings Of Packaged Solid State Lighting Devices (Substitute Claim 21[e])

36. Substitute claim 21[e] is directed to a controller to control the strings of packaged LEDs. Using a controller to drive, or control, strings of LEDs was well-known in the art, as shown by a number of references.

37. Mueller, for example, describes and shows in Figure 2 that “lighting system 200 may include one or more lighting unit controllers (hereinafter “LUCs”) 208A, 208B, 208C and 208D, which are controlled by a central controller 202.” Mueller, [0189]. These controllers are used to control the lighting units 100. *Id.*,

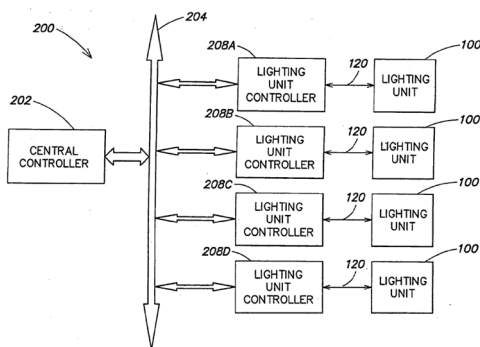


Fig. 2.

FIG. 2

38. Grootes further demonstrates the obviousness of substitute claim 21[e], describing terminals “coupled to a PWM controller,” through which “[e]ach

current source 40-42 is controllable to control the brightness of its associated LEDs to achieve the desired white point” and “the brightness of each string of LEDs may be separately controlled by an external PWM or amplitude modulation controller (operating in conjunction with the aforementioned PWM controllers) to allow the user to adjust the brightness and white point to meet the particular specifications of the user.” Grootes, [0017], [0041]. Thus, the PWM controller is configured to control Grootes’ “strings of LEDs.” Grootes, [0010].

F. Wherein The Controller Is Operable To Deliver A Control Signal To A Plurality Of Current Supply Circuits That Are Operable To Control The Pulse Width Of The Current Supplied To Each One Of The Plurality Of Strings Of Packaged Solid State Lighting Devices Using Information Transmitted To The Controller Over A Communication Link (Substitute Claim 21[f])

39. Using the controller described above to deliver control signals to the current supply circuits over a communication link to control the pulse width of the current supplied to each string of packaged LEDs was well known in the art as of April 2006 as well. Indeed, PWM controllers were well known in the field and commonly used to address efficiency and wavelength in LED devices, as this is the purpose of pulse width modulation.

40. For example, Mueller describes and shows in Figures 2 and 69 that “control signals that may be generated by the processor to control the light sources include ... pulse width modulated signals (PWM)” Mueller, [0156]. In Mueller, “the lighting system 200 may include one or more lighting unit controllers

(hereinafter "LUCs") 208A, 208B, 208C and 208D, wherein each LUC is responsible for communicating with and generally controlling one or more lighting units 100 coupled to it" as well as stating "each LUC in turn may be coupled to a central controller 202 that is configured to communicate with one or more LUCs." Mueller, [0189]-[0190].

41. The controllers 202/208 send control signals based on information from a communication facility 120, which is a communication link. Mueller, [0272]. The control signals may be "pulse width modulated signals (PWM)." Mueller, [0156]. The PWM control signals go from controller 202 to communication facility/coupling device 204 that, as shown in Figure 2, a POSITA would understand connects to a plurality of circuits on which are the lighting units 100. Mueller, [0156], [0276], Fig. 2.

42. Grootes also discloses "A programmed microprocessor, a memory, or other controller may provide the control signals to the PWM controller. The AM values stored in the on-board memory 47 are used to offset intrinsic variations between the LED strings. FIG. 5 illustrates any of the PWM controllers 50, connected to a PWM control line in FIG. 4, that receive a control signal to vary the duty cycle of an oscillator operating at a fixed frequency." Grootes, [0048]-[0049].

43. A POSITA would understand that “programmed microprocessor, a memory, or other controller” sends information to the PWM controller through a communication link.

44. As shown in Figure 4, the PWM controller in Grootes is connected to PWM controls lines which “receive a control signal”. Grootes, [0035], Fig. 4. The control signal is sent to the control lines to the control the pulse width of current sources, and each individual LED string is connected to its own current source. Mueller, Fig. 4, [0035]-[0037], [0048]-[0049].

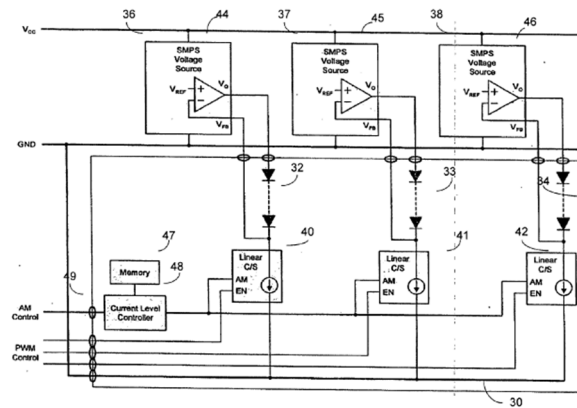
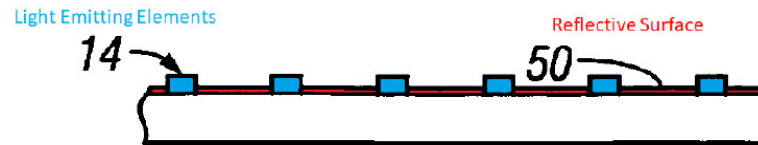


Fig. 4

G. A Reflector Mounted To The Lighting Tile And On The First Side Of The At Least One Substrate, The Reflector Being Outside Of The Packaged Solid State Lighting Devices (Substitute Claim 21[g])

45. Mounting a reflector outside of the packaged LEDs to the lighting tile on the first side of the substrate is disclosed by a number of references. For example, as shown in Figure 1 of Mok, “The reflective surface 50 may comprise a separate component (e.g., a sheet-like material) that is affixed to the base panel 12.

Alternatively, the reflective surface 50 may be deposited directly on the base panel 12 by any of a wide range of processes suitable for depositing the particular type of reflective material that is to be used.” Mok, [0021].

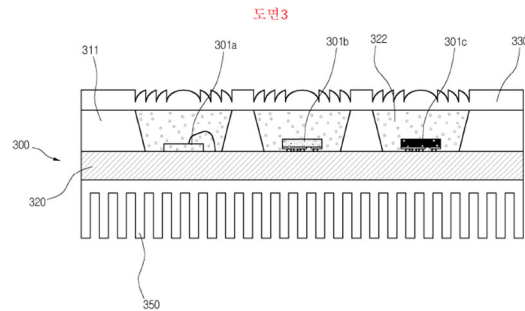


46. Epstein discloses substitute claim 21[g] as well, stating that “The intermediate layer 422 includes apertures 423, also referred to as vias, that are registered to the LEDs 420 disposed on the substrate 408. The intermediate layer 422 may be reflective for light at the wavelength emitted by the LED 420.” Epstein, [0048]. And as shown in Figure 4A, the intermediate layer is outside of the LEDs.

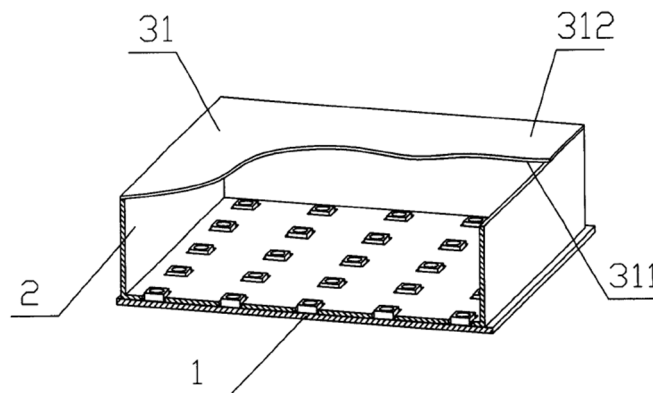
47. Ayabe also teaches a “reflecting member 57 on the wiring board 55,” which is a substrate. Ayabe, [0127]. The reflecting member “is comprised of a plurality of annular reflecting areas 64a, 64b, 64c” and is outside of the “light emitting devices 56R, 56G, and 56B.” Ayabe, [0095], [0097], Fig. 1, Fig. 15.

48. Further, Park describes a “mounting a reflection cup part on the wiring part on which the light emitting diodes are mounted to reflect light” and states that “a reflection coating treatment by Ag may be performed on a surface of an inner area of the reflection cup part in which the light emitting diode is

mounted.” Park, 5. As shown in Figure 3, the reflective cup is mounted on the wiring part outside of the LED packages. Park. Fig. 3.



49. Li also discloses substitute claim 21[g], stating that “RGB unit-packaged LEDs are soldered onto an aluminum-based PCB 12” Li, 5. Li then goes on to disclose a reflector on the PCB, stating “[t]he reflector 2 is a square box, as shown in FIG. 5. The reflector’s top is open and its bottom has a plurality of small apertures 21, corresponding to the positions of the LED light sources on the aluminum-based PCB.” Li, 8. Thus, the reflector is mounted to the PCBs and is outside of the packed LEDs. Li, Fig. 5.



H. Wherein The Reflector Extends To Cover The Lighting Tile And Includes A Plurality Of Sidewalls Outside Of The Packaged Solid State Lighting Devices That Are Angled With Respect To The Principal Plane Of The Lighting Panel (Substitute Claim 21[h])

50. Substitute claim 21[h] is directed to common, well-known elements, as demonstrated, for example, by Epstein. Epstein discloses an intermediate layer that is placed on the substrate and may comprise a “a multi-layer polymer reflective film” a “white diffuse reflector,” or “some other type of reflector.” Epstein, [0048].

51. Epstein also states that “Epstein states that the aperture in the intermediate layer 522 may be sized larger than the LED 520.” Epstein, [0062]. A POSITA would understand that the intermediate layer would have sidewalls forming this aperture, which is a common, well-known arrangement for a reflector. These sidewalls would need to be angled with respect to the substrate 408 to leave space for the LEDs that are arranged on the substrate. Epstein, [0048]. As shown in Epstein, these LEDs are outside of the reflector (intermediate layer), which covers the substrate. Epstein, Fig. 4A.

52. Next, Holman discloses “Sloped sidewalls 230 are used to increase the amount of LED light coupled to the cavity's output aperture of width W, 42. The sloped sidewall can be a diffusely reflecting material identical to the base layer material 220 or deposited as an external coating. The sloped sidewall 230 can also

be made specularly reflecting.” Holman, 37. The reflector with sloped sidewalls 230 covers the base layer 220. Holman, Fig. 14.

53. Lamb also discloses “a shaped reflector 17 located behind the array of light bulbs 15 for directing more light toward a viewer.” Lamb, [0034]. The shaped reflector has angled sidewalls that are outside of the light bulbs 15, which may be LEDs. Lamb, Fig. 1, [0039].

54. Next, Saccomanno teaches and shows, in Figure 5 for example, a reflective surface 505 with sidewalls that are angled with respect to a substrate 410, upon which the LEDs 100 are mounted. Saccomanno, [0038]- [0039]. The sidewalls of this reflector are outside of the LEDs 100. Saccomanno, Fig. 5.

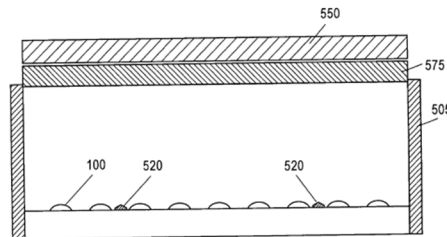
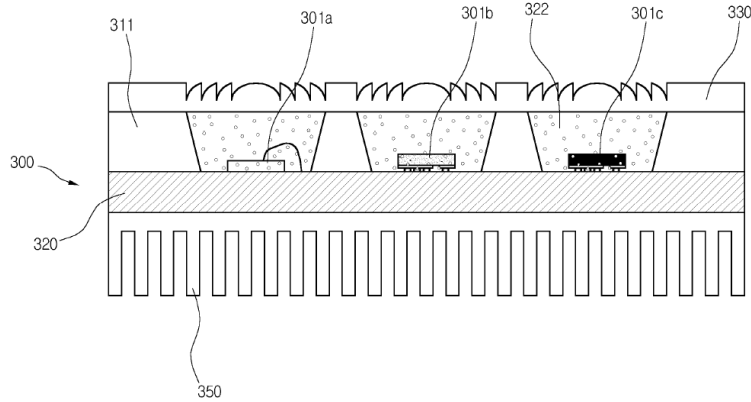
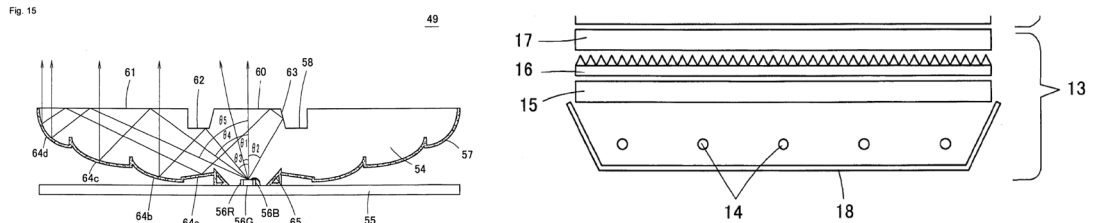


FIG. 5

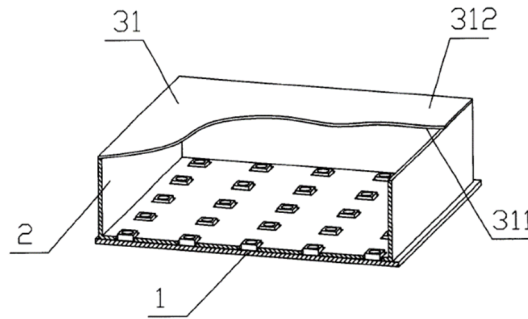
55. Park also discloses a “reflection cup part 311 [that] is attached to the wiring part 320 on which the LED chips 301a, 301b, 301c are mounted.” Park, 6. As shown in Figure 3, the reflecting cup 311 has sidewalls that are angled with respect to the principal plane of the lighting panel, which is defined by the wiring board 320 that the LEDs 301 are mounted on. Park, Fig. 3.



56. Ayabe also discloses a reflecting member 57 that has angled sidewalls and covers the wiring board 55, upon which the light emitting devices 56R, 56G, and 56B are mounted. Ayabe, [0091]-[0092]. As shown in Figures 1 and 15, the angled sidewalls of the reflector are outside of the LEDs.



57. Li also states that “The reflector 2 is a square box” which “has a plurality of small apertures 21, corresponding to the positions of the LED light sources on the aluminum-based PCB.” Li, 8. As shown in Figure 1 of Li, the reflector box’s sidewalls are angled with respect to the PCB, and are outside of the LED light sources.

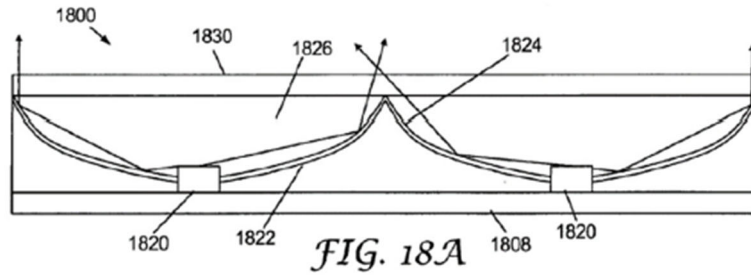


I. Wherein The Generally Planar Diffuser Contacts The Reflector (Substitute Claim 21[i])

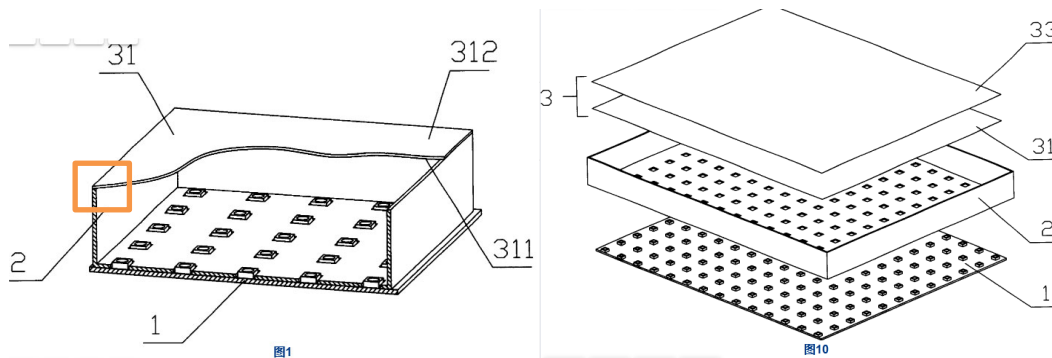
58. A generally planar diffuser in contract with a reflector is yet another well-known claim element.

59. Mok, for example, states that “diffuser 16 may be mounted in front of the base panel 12 and separated therefrom by a spaced-distance 48” where the distance is “50 millimeters (mm) or less.” Mok, [0023]. Mok goes on to state that larger distances are “expense of panel thickness and some loss of efficiency.” Mok, [0023]. Thus, a POSITA would understand that smaller distances are desirable, and that distances less than 50mm could be a distance of zero. Further, Mok goes on to state that “brightness enhancer 18 is preferably stacked directly on (or applied to) the diffuser,” recognizing that having direct contact of the layers is preferable. The claims of Mok also disclose a diffuser “positioned adjacent said base panel,” further supporting that Mok teaches direct contact between its layers. Mok thus discloses or renders obvious substitute claim 21[i].

60. Next, Epstein discloses a “sheet 1822” that “may be formed of reflecting material.” Epstein, [0107]. This reflective sheet is placed in direct contact with a diffuser 1830, as shown, for example, in Figure 18A. Epstein, [0109], Fig. 18A.

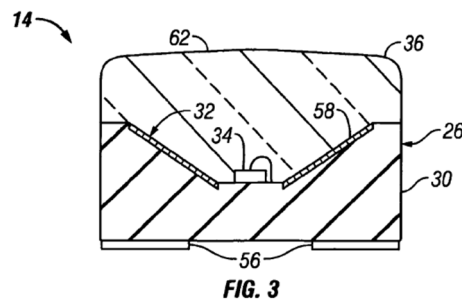


61. Li discloses substitute claim 21[i] as well, stating that “[a] scattering layer 31 is mounted on one side of the reflector’s opening. The function of this scattering layer is to diffuse the light illuminated on the incident surface 311, thereby achieving relatively uniform light on the light emission surface 312.” Li, 8. This scattering layer, which is a diffuser, is depicted as a generally planar layer that is in contact with reflector 2. Li, 8, Fig. 1, Fig. 18.

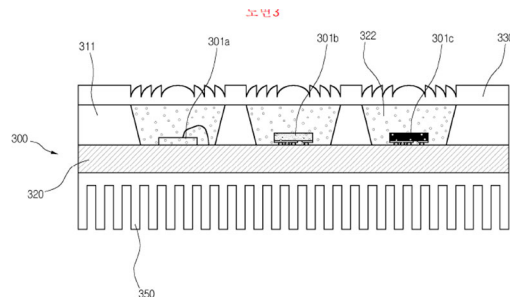


J. Wherein The Lens Surrounds Each Of The Packaged Solid State Lighting Devices (Substitute Claim 22)

62. Substitute claim 22 is disclosed by Mok, which describes a “lens 36” that is “formed over the diode junction 34 and reflector cup 32 in the manner best seen in FIG. 3.” Mok, [0029], Fig. 3.



63. Park also discloses substitute claim 22 describing and showing, for example in Figure 3, a lens part 330 that surrounds LEDs 301a, 301b, 301c. Park, 6, Fig. 3.



64. Li discloses substitute claim 22 as well, stating that “above each RGB unit-packaged LED light source in the light source module, there is a lens (light diffuser) designed using the principles of a binary optical system. The optical structure of this lens can be designed according to actual needs, resulting in a specific and relatively uniform radiation pattern, which greatly simplifies

subsequent optical design.” Li, 10. Based on this disclosure, a POSITA would understand that the lens in Li surrounds the packaged LEDs, as surrounding the LEDs with the lens placed above allows for greater amounts of light to be captured by the lens, leading to more uniform lighting as sought by Li.

K. Wherein The Generally Planar Diffuser Contacts The Sidewalls Of The Reflector With No Intervening Elements (Substitute Claim 23)

65. Substitute claim is disclosed by Epstein, which teaches a guiding layer 610 with a diffuser that is generally planar, and an intermediate layer 622 that is used to reflect light. Epstein, [0075], [0084]. As shown by Figure 11, the diffuser (guiding layer 610) is in direct contact with the reflector (intermediate layer 622). Epstein, Fig. 11, [0074]-[0075].

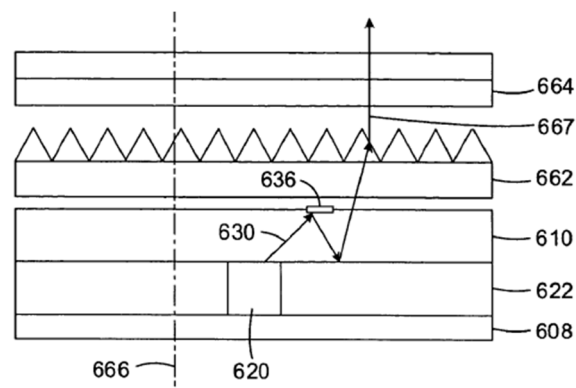
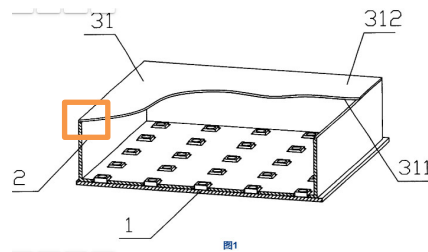


FIG. 11

66. In Figures 14 and 15, Holman also shows a “diffusing layer 68” which is generally planar and in direct contact with sloped sidewall 230, which “can also be made specularly reflecting.” Holman, 38, 43.

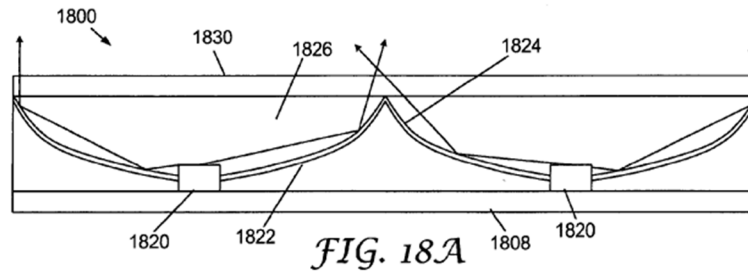
67. Next, Li discloses that “[a] scattering layer 31 is mounted on one side of the reflector’s opening. The function of this scattering layer is to diffuse the light illuminated on the incident surface 311.” Li, 8. As shown in Figure 1, for example, the scattering layer 31 is in direct contact with the reflector 2. Li, Fig. 2.



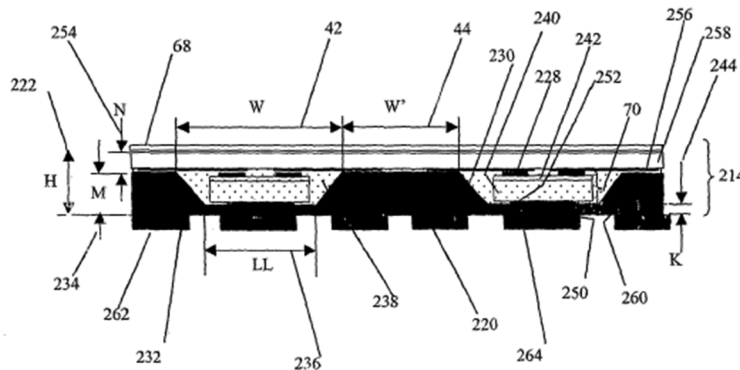
L. Wherein The Generally Planar Diffuser Is Offset From The Packaged Solid State Lighting Devices (Substitute Claim 24)

68. Substitute claim 24, in combination with the prior substitute claims, essentially creates a basic light mixing chamber, which was ubiquitous in the art, used in a wide range of lighting panel systems. Thus, a generally planar diffuser offset from packaged LEDs was a common concept, disclosed by a number of prior art references.

69. Epstein, for example, teaches “LEDs 1820 disposed on a substrate 1808” in addition to a diffuser 1830. Epstein, [0106], [0109]. As shown in Figure 18A of Epstein, the LEDs are offset from the diffuser.



70. Similarly, Figures 13-15 of Holman show a “light diffusing sheet 68” that is offset from LEDs 70. Holman, 52, Figs. 13-15.



M. Wherein The Controller Transmits Control Signals To A Plurality Of Current Supply Circuits (Substitute Claim 25)

71. Using a controller to transmit control signals to a plurality of current supply circuits is another well-known claim element. For example, in Figure 2, Mueller shows a central controller 202 and lighting unit controllers 208 that transmit control signals to multiple circuits to a number of circuits, on which are lighting units 100. Mueller, Fig. 2. [0156], [0276].

72. Grootes also states that “Each current source 40-42 is controllable to control the brightness of its associated LEDs to achieve the desired white point.

Each current source may be that shown in FIG. 1, 2, or 3, with control inputs being Vref (or Iset) and enable (EN). In FIG. 4, the Vref or Iset terminals are labeled AM (amplitude modulation), and the EN terminals are coupled to a PWM controller. Either the magnitude of AM or the duty cycle of EN may be used to control the brightness of the respective LEDs. The AM lead is used to control the “linear” conductivity of the pass transistor 14 when the current source is enabled by the signal EN.” Grootes, [0041]. Each current source is controllable through control signals sent from the PWM controller to PWM control lines, which a POSITA would understand are a plurality of current supply circuits. Grootes, [0049].

N. Wherein At Least One Of The Current Supply Circuits Transmit Pulse Width Modulated Signals To One Or More Of The Plurality Of Strings Of Packaged Solid State Lighting Devices (Substitute Claim 26)

73. Mueller describes controlling the lighting units with PWM signals stating that “examples of control signals that may be generated by the processor to control the light sources include ... pulse width modulated signals (PWM)” Mueller, [0156], Fig. 2, Fig. 69. As shown in Fig. 2, the PWM control signals from the PWM controller are sent to the lighting units for current control. Mueller, Fig. 2.

74. Grootes also states that “Each current source 40-42 is controllable to control the brightness of its associated LEDs to achieve the desired white point. Each current source may be that shown in FIG. 1, 2, or 3, with control inputs being

Vref (or Iset) and enable (EN). In FIG. 4, the Vref or Iset terminals are labeled AM (amplitude modulation), and the EN terminals are coupled to a PWM controller. Either the magnitude of AM or the duty cycle of EN may be used to control the brightness of the respective LEDs.” Grootes, [0041]. Thus, the signals from the PWM controller are sent to the strings of LEDs over PWM control lines. Grootes, [0049], Fig. 4, 7.

O. Wherein The Current Supply Circuits Are Operable To Individually Control The Current To Each Of The Strings Of Packaged Solid State Lighting Devices (Substitute Claim 27)

75. Grootes states that the cathode of each LED string is “connected to its own current source 40, 41, 42.” Grootes, [0036]-[0037]. Thus, when the control signals are sent from the PWM controller, “each string of LEDs may be separately controlled” through its separate current source. Grootes, [0017].

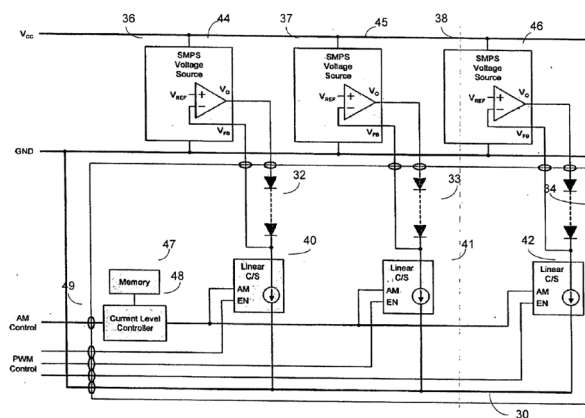


Fig. 4

P. Wherein The Pulse Width Modulation Of The Current Delivered To Each Of The Strings Of Packaged Solid State Lighting Devices Is Based On One Or More Of: User Input, Ambient Light Information Or Other Input (Substitute Claim 28)

76. Grootes teaches that “the brightness of each string of LEDs may be separately controlled by an external PWM or amplitude modulation controller (operating in conjunction with the aforementioned PWM controllers) to allow the user to adjust the brightness and white point to meet the particular specifications of the user” and “[t]he PWM signals are then set by the user to achieve the desired white point.” Grootes, [0017], [0043]. Thus, in Grootes, the user can control the PWM signals through user input.

Q. Wherein The Reflector Is Substantially Planar To The Surface Of The Lighting Tile Where The Reflector Is On The At Least One Substrate (Substitute Claim 29)

77. Mok describes and shows, for example, in Figure 1 a “reflective surface 50” that may comprise a “sheet-like material” and is “affixed to the base panel 12.” Mok, [0021]. Thus, the planar reflector sheet is on the base panel, which is a substrate.

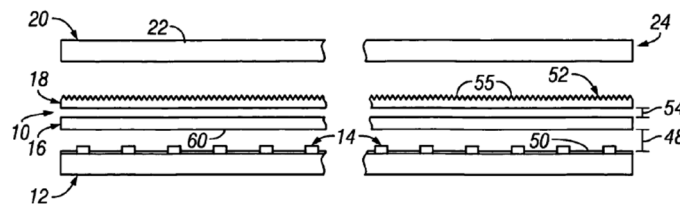


FIG. 1

78. Epstein also discloses “an intermediate layer 622, which may be a reflecting film” and is disposed on “substrate 608.” Epstein, [0067]. As shown, for example in Figure 11, the intermediate layer 622 is a planar layer on the substrate 608.

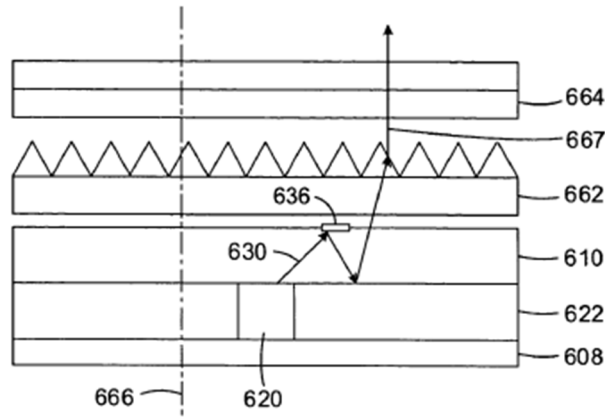


FIG. 11

V. Motivations to Combine.

A. It Would Have Been Obvious to Incorporate the Teachings of Ayabe, Saccomanno, Park, Li, Mueller, or Grootes with the Prior Art of Ground I or Ground II.

79. For similar reasons expressed in my original declaration for combining the prior art of Ground I (Mok, Holman, and Lamb), it would have been obvious to combine any of Park, Li, Mueller, and/or Grootes with the prior art of Ground I or Ground II. And as expressed in my declaration in response to Patent Owner’s contingent motion to amend (Ex. 1022) it would have been obvious to combine Ayabe and/or Saccomanno with the prior art of Ground I or Ground II.

80. For example, Park, Li, Mueller, or Grootes all relate to the same field of endeavor as Mok, Holman, and Lamb, i.e., LED based lighting devices to provide backlighting for display elements. The same is true of the Ground II art (Epstein, Holman, and Lamb). Moreover, each of Park, Li, Mueller, and/or Grootes employ similar structures and components as the Ground 1 and Ground 2 references, including LEDs, substrates, reflectors, diffusers, and brightness enhancement films.

81. Further, a POSITA, when looking at the art of Grounds I or II along with Park, Li, Mueller, and/or Grootes, would realize that although these references particularly focus on certain elements of the common lighting systems (i.e., Mok focuses on the arrangement of layers in a lighting system, Grootes focuses on its PWM controller, and Li focuses on the box-like structure of its reflector and diffuser to create an optical cavity), all the references discussed herein generally relate to the same sorts of systems. A POSITA would look to and combine these references because they all focus on the same types of systems generally, while making the best embodiment of particular components within those general lighting systems.

82. A person of ordinary skill in the art reviewing the teachings of Park, Li, Mueller, and/or Grootes would recognize that incorporating the elements discussed above of any of Park, Li, Mueller, and/or Grootes into the combination

of Mok, Holman, and Lamb would improve efficiency as well as the quality and uniformity of light output by the backlight system.

83. Indeed, when reviewing the disclosures of substitute claims 21, 22, 23, 24, and 29, a POSITA would recognize that these claims are directed at a common arrangement of a reflector, diffuser, lens, and LED to create an optical cavity for light mixing. It was well known that such a chamber, as described in Park and Li for example, could be used for greater and more uniform light output.

84. Indeed, Park states that using its system for a “a light emitting diode package... achieves excellent heat dissipation while maintaining high luminance” due to its “reflection cup part coupled to the wiring part to reflect light of the light emitting diodes; and [] lens part disposed on the reflection cup part to irradiate light generated in the light emitting diodes to an outside.” Park, Abstract. Park also states, for example, that “A reflection cup part 311 is disposed to enhance light efficiency of the LED chips 301a, 301b, 301c mounted on the wiring part 320, and the reflection cup part 311 serves to enhance light efficiency of the LED chips 301a, 301b, 301c mounted on the wiring part 320 while supporting the lens part 330.” Park, 6.

85. Similarly, Li states that using its “LCD backlight system using three-primary-color (RGB) unit-packaged LEDs... a reflector, and a light diffuser”

achieves “high brightness,” “uniform light on the light emission surface,” and better light mixing. Li at 5-6.

86. A POSITA would also recognize that Substitute Claims 21, 25, 26, 27, and 28 are aimed at the basic concept of controllers for pulse width modulation. It was ubiquitous to use such controllers in lighting systems, such as those in Mueller and Grootes, to gain greater control and efficiency in a system.

87. Mueller, for example, states that use of its lighting system and PWM controller “improve the quality of lighting in environments” and lead to “improved control over illumination.” Mueller, Abstract, [0036]. Mueller goes on to recognize that where “LEDs are modulated with PWM” a more efficient system can be created, which “maximize[s] the light output from the LED while maintaining an acceptable lifetime.” Mueller, [0159].

88. Grootes also recognizes that PWM controllers as used therein lead to more efficient, better controlled lighting systems, stating “color and brightness uniformity is improved” and “maximum efficiency” can be achieved. Grootes, Abstract, [0009], [0050].

89. Thus, a person of ordinary skill in the art would be motivated to make these modifications to improve the quality and efficiency of light output. Accordingly, it would have been obvious to one of skill in the art to employ the

teachings of Park, Li, Mueller, and/or Grootes with each of the prior art in Ground I or Ground II.

90. Specifically, with respect to Ground 1 and Mok, a POSITA would be motivated to combine Mok's base panel with the wiring portion of Park or the MCPCB of Li. And with respect to Ground 2 and Epstein, a POSITA would be motivated to combine the tile in Mok with the wiring portion of Park or the MCPCB of Li to create "at least one substrate comprising a metal core printed circuit board having traces formed thereon mounted on a lighting tile." As described above, MCPCBs were well known in the art, and have a variety of advantages such as improved heat dissipation and, durability, and reduced vibration. *See, e.g.*, Sloan, [0039]. Thus, a POSITA would be motivated to combine Mok or Epstein with Park or Li to gain these advantages, including enhanced cooling and longevity, which both Mok and Epstein explicitly state they seek. *See, e.g.*, Mok, [0004]-[0006]; Epstein, [0054].

91. A POSITA would also be motivated to combine Mok's LEDs (Ground 1) or Epstein's packaged LEDs (Ground 2) with the strings of LEDs in Grootes, and the LED packages of Holman, Park, or Li to create a "plurality of strings of packaged solid state lighting devices." Strings of LEDs and packaged LEDs were both extremely well-known and common off-the-shelf components, as shown, for example, by Epstein, which states "Traditionally, the manufacture of a

LED array thus includes steps for encapsulating the LED die within an encapsulated package, and then locating and placing the encapsulated package within the array.” Mok, [0003]. A POSITA would be motivated to use strings of packaged LEDs to create brighter lighting at lower cost, using more durable lighting elements because of the protection from the LED packages. These benefits are also expressly sought by both Mok and Epstein. *See, e.g.*, Mok, [0004]-[0006]; Epstein, [0038].

92. A POSITA would also be motivated to combine Mok’s LEDs mounted on a base panel (Ground 1) or Epstein’s LEDs mounted on a substrate (Ground 2) with the LEDs mounted on the wiring part of Park, LEDs soldered to the PCB of Li, or the LEDs mounted to a PCB in Grootes to create a “plurality of strings of packaged solid state lighting devices is mounted on the lighting tile.” A POSITA would recognize that this arrangement of LEDs on the lighting tile would create more uniform lighting, as sought by Mok and Epstein, and would be motivated to make this modification to achieve more uniform lighting. *See, e.g.*, Mok, [0001]; Epstein, [0088].

93. A POSITA would also be motivated to combine Mok’s lens-covered LEDs (Ground 1) or Epstein’s LEDs (Ground 2) with the lens mounted over LEDs in Holman, lens portion mounted over the LEDs in Park, or lens over the LEDs in Li to create “a lens [] mounted over each one of the packaged solid state lighting

devices.” Mounting a lens over LEDs was common in the art, and advantageous because it allows greater light collection from the LEDs and thus greater, more efficient light emission from the lighting system. This is a goal of both Mok and Epstein, and a POSITA would have been motivated to apply a lens to these LED systems in order to achieve a more efficient lighting system. *See, e.g.*, Mok, [0001]; Epstein, [0088].

94. A POSITA would be motivated to combine Mok’s LEDs (Ground 1) or Epstein’s LEDs (Ground 2) with the lighting unit controller and central controller of Mueller or the PWM controller in Grootes to create “a controller configured to control the plurality of strings of packaged solid state lighting devices.” Utilizing a PWM controller was a well known way of permitting greater control over a lighting system, and also creating more efficient lighting. These benefits are sought by both Mok and Epstein, and a POSITA would have been motivated to modify Mok and Epstein to include PWM controllers in order create more efficient lighting. *See, e.g.*, Mok, [0006]; Epstein, [0121].

95. A POSITA would also be motivated to combine Mok’s LEDs (Ground 1) or Epstein’s LEDs (Ground 2) with the lighting unit controller and central controller sending PWM control signals over the communication facility through the coupling device of Mueller or the PWM controller sending control signals over PWM control lines based on information from a microprocessor in

Grootes to create a “controller [that] is operable to deliver a control signal to a plurality of current supply circuits that are operable to control the pulse width of the current supplied to each one of the plurality of strings of packaged solid state lighting devices using information transmitted to the controller over a communication link.” As I previously explained, pulse width modulation through a PWM controller was a common way of controlling the wavelength of LEDs for greater efficiency. And both Mok and Epstein seek to create more efficient lighting systems. *See, e.g.*, Mok, [0006]; Epstein, [0121]. A POSITA would have been motivated to use such a known PWM controller in order to enhance the efficiency of the LED systems of Mok and Epstein.

96. A POSITA would be motivated to combine Mok’s reflective surface (Ground 1) or Epstein’s intermediate layer (Ground 2) with the reflector of Ayabe, reflective cup of Park, or reflector of Li to create “a reflector mounted to the lighting tile and on the first side of the at least one substrate, the reflector being outside of the packaged solid state lighting devices.” A POSITA would have been motivated to utilize a reflector outside of packaged LEDs because a POSITA would have recognized that including such a reflector is beneficial for collecting greater amounts of light from the LEDs. This leads to brighter, more luminous lighting, as sought by Mok and Epstein. *See, e.g.*, Mok, [0004]-[0006]; Epstein, [0038].

97. A POSITA would also be motivated to combine Mok’s reflective surface (Ground 1) or Epstein’s intermediate layer (Ground 2) with Holman’s sloped sidewall, Lamb’s reflector with angled sidewalls, Saccomanno’s reflective surface with angled sidewalls, Park’s reflector cup with angled sidewalls, Ayabe’s angled reflecting member, or Li’s box shaped reflector to create a “reflector [that] extends to cover the lighting tile and includes a plurality of sidewalls outside of the packaged solid state lighting devices that are angled with respect to the principal plane of the lighting panel.” Utilizing a reflector with angled sidewalls outside of the LEDs would further help with light collection, as it would give greater surface area for gathering light. A POSITA would have recognized that this modification would have beneficially led to brighter lighting, as sought by Mok and Epstein. *See, e.g.,* Mok, [0004]-[0006]; Epstein, [0038].

98. A POSITA would be motivated to modify Mok’s diffuser (Ground 1) or Epstein’s diffuser (Ground 2) based on Li’s scattering layer to create a “generally planar diffuser [that] contacts the reflector.” Utilizing a diffuser that contacts the reflector would help spread light from the reflector for brighter lighting, as well as help create a thinner lighting panel. Brighter lighting and a thinner lighting panel are sought by Mok and Epstein, and a POSITA would have been motivated to modify Mok or Epstein’s diffuser to include a scattering layer to

enable a thinner panel with brighter lighting. *See, e.g.*, Mok, [0004]-[0006], [0023]; Epstein, [0003], [0038].

99. A POSITA would be motivated to combine Mok's lens and LEDs (Ground 1) or Epstein's LEDs (Ground 2) with Park's lens portion or Li's lens to create a "lens [that] surrounds each of the packaged solid state lighting devices." A POSITA would recognize that such a lens would help with light collection for greater, more uniform illumination, as sought by both Mok and Epstein, and thus would have been motivated to make this combination. *See, e.g.*, Mok, [0016], Epstein, [0088].

100. A POSITA would be motivated to combine Mok's reflector and diffuser (Ground 1) or Epstein's guiding layer and intermediate layer (Ground 2) with Holman's diffuser and sloped reflective sidewall to create a "generally planar diffuser [that] contacts the sidewalls of the reflector with no intervening elements." A POSITA would also be motivated to combine Mok's diffuser and LEDs (Ground 1) or Epstein's LEDs and diffuser (Ground 2) with Holman's diffuser and LEDs to create a "generally planar diffuser [that] is offset from the packaged solid state lighting devices." These claim elements create a basic light mixing chamber. This was a well-known way of creating more uniform, brighter illumination, which is sought by both Mok and Epstein, and thus a POSITA would have been motivated

to use the well-known technique of a light-mixing chamber to obtain higher quality light output. *See, e.g.,* Mok, [0016], Epstein, [0088].

101. A POSITA would be motivated to combine Mok's LEDs (Ground 1) or Epstein's LEDs (Ground 2) with Mueller's central controller and LUCs that transmit control signals to multiple circuits through a communication facility/coupling device or Grootes' PWM controller connected to PWM control lines and LEDs with their own current source to create a "controller [that] transmits control signals to a plurality of current supply circuits." A POSITA would also be motivated to combine Mok's LEDs (Ground 1) or Epstein's LEDs (Ground 2) with Muller's PWM signals and current supply circuits or Grootes' PWM control signals for each current source to create a system "wherein at least one of the current supply circuits transmit pulse width modulated signals to one or more of the plurality of strings of packaged solid state lighting devices." A POSITA would further be motivated to combine Mok's LEDs (Ground 1) or Epstein's LEDs (Ground 2) with Grootes' LED strings with separate current sources to create a system "wherein the current supply circuits are operable to individually control the current to each of the strings of packaged solid state lighting devices."

102. As set forth above, PWM modulation was a well-known way of controlling current and wavelength in lighting devices. Further, by utilizing a

plurality of current supply circuits to deliver PWM control signals to individual LED strings, there would be greater control over the lighting system for more efficient and precise lighting. This is a benefit sought by both Mok and Epstein. *See, e.g.*, Mok, [0006], Epstein, [0121].

103. A POSITA would also be motivated to combine Mok's LEDs (Ground 1) or Epstein's LEDs (Ground 2) with Grootes' PWM controller that is adjustable by user specifications to create a system "wherein the pulse width modulation of the current delivered to each of the strings of packaged solid state lighting devices is based on one or more of: user input, ambient light information or other input." By allowing the PWM modulation to be based on factors such as user input, the user of the lighting system would have greater control over the illumination. Further, adapting to factors such as user input of ambient light information would lead to greater efficiencies, such as not requiring as much power when less lighting is needed or desired. Greater efficiencies such as these are a goal of both Mok and Epstein. *See, e.g.*, Mok, [0006], Epstein, [0121].

I hereby declare that statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. Should further information become available to me as this matter proceeds, I may

revise my opinions accordingly as necessary. I declare under penalty of perjury
that the foregoing Declaration is true and correct.

October 15, 2024
Date



Dr. P. Morgan Pattison